43/6.

UNIVERSITY OF NATAL

PIETERMARITZBURG

SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —

Union Department of Forestry

REPORT FOR 1956–1957

(TENTH YEAR)

OCTOBER, 1957

COMMONWEALTH MYCOLOGICAL INSTITUTE
18 NOV 1957

UNIVERSITY OF NATAL
PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1956–1957

(TENTH YEAR)

OCTOBER, 1957

CONTENTS

	Page
Committee of Control of The Institute	4
List of Staff	5
Foreword	6
Administrative Report:	
Buildings and Plantations	7
Administration and Finance	8
Staff	9
Advisory Work, Committees, Conferences, etc.	10
Library	12
Acknowledgements	12
Review of Work in Progress:	
(*a*) Silviculture	13
(*b*) Genetics and Plant Breeding	16
(*c*) Chemistry	19
(*d*) Entomology	23
(*e*) Biometry	25
Progress Reports and Papers:	
A List of Fungi Collected in Wattle Plantations. K. Roberts	26
Notes on Insects Observed during the period 1956-1957. L. L. J. Ossowski	29
Publications	32

COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3):

S. Clegg, Esq. (*Chairman*).

Major C. J. J. Crowe.

R. B. Fyfe, Esq.

Appointed by the University of Natal (2):

Professor A. J. W. Bayer, D.Sc. (*Vice-Chairman*).

Principal E. G. Malherbe, M.A., Ph.D., LL.D.

Alternate: Professor A. R. Saunders, D.Sc.Agric. (*Resigned March*, 1957).
H. H. Cornell, Esq., B.A. (*Appointed April*, 1957).

Appointed by the Union Government Department of Forestry (1):

C. E. Lack, Esq., B.Sc.

The Director:

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary:

P. G. Leeb-duToit, Esq., B.Com. (Registrar, University of Natal).

STAFF

(SEPTEMBER, 1957)

DIRECTOR:

H. Shaw, M.Sc.Tech., Ph.D.(Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A.(Oxon.), B.Sc.(South Africa).
K. Roberts, B.Sc.(Wales).

Technical Assistants:

M. J. Lourens.
A. M. MacKenzie.
J. H. Scheltema (*Resigned January*, 1957).
I. S. Alexander (*Appointed May*, 1957).

Genetics and Plant Breeding:

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc.(Natal).

Technical Assistant:

B. L. Arbuthnot.

Chemistry:

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc.(Natal).

Technical Assistant:

R. A. Jones.

Entomology:

L. L. J. Ossowski, M.F., For.Ing., D.Sc.(Poznan).

Technical Assistants:

G. B. Wortmann.
R. R. Hawkins (*Resigned January*, 1957).
J. A. Nagle (*Appointed October*, 1956; *resigned February*, 1957).
J. A. Hunt (*Appointed March*, 1957).

Biometry:

E. R. Vaughan, B.Sc.Hons.(Natal).

Administration:

Miss E. K. Smith.

Non-European:

Eight.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

During the past year, the tenth anniversary of the formal inauguration of the Institute in May, 1947, passed almost unnoticed. This is a short span in the life of an agricultural research institute, especially one dealing with a relatively long-lived crop, but it has been sufficient for the general pattern of the Institute's work to take shape. It has been, in the main, a period of preparation and initiation, and many of the long-term projects started are not yet yielding their earliest results. Nevertheless, some results of considerable significance have already been obtained. It is probable, however, that the greatest service rendered by the Institute during this introductory period has been its advisory work, especially in the fields of general silviculture and pest control. Certainly this has been its main impact upon wattle growers. Moreover, in addition to the local advisory work, enquiries have been received and answered from 39 different countries and territories outside South Africa. These enquiries have arisen largely out of the Institute's published work, although this is only now beginning to appear in any quantity in the well-known scientific journals. During the year under review, five such papers have been published and five others accepted for publication.

The presentation of this Annual Report cannot be allowed to pass without a tribute to the late Mr. J. Hunt Holley, M.Sc.Agric.(*honoris causa*), who died on the 31st March, 1957. Although Mr. Holley was ending his active participation in wattle affairs when the Wattle Research Institute was inaugurated, he had been one of the first and one of the strongest advocates of the establishment of such an organization, and right up to the time of his death, was one of its staunchest and most enthusiastic friends. His record of persistent advocacy of research goes back more than fifty years, and it was most fitting that in 1950, his great services to agriculture in general and to the wattle industry in particular should be recognized by the conferment of an Honorary Degree by the University of Natal.

H. SHAW, *Director.*

October, 1957.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Building.

The first few weeks of the year saw the completion of the additions to the Chemistry Section. In addition to providing much-needed storage space, these extensions have greatly facilitated the handling of the rapidly increasing number of bark samples coming in for analysis from the many and widespread experimental plots controlled by the Institute.

Later in the year, the first internal re-decoration of the building since its erection was undertaken. This provided the opportunity to modify certain unsatisfactory features and has produced a very pleasing result. The building is now in a good state of repair and decoration, both internally and externally. In the course of this work, the three phases of incoming electric current were balanced by re-distribution of the circuits, but it was later found necessary to carry out some re-wiring to obviate heavy overloading in several circuits.

Minor alterations were effected in the insectary and in the nursery propagation frame.

It is now clear that the labour resources available to the Institute are quite inadequate to cope with the work of completing the layout of the surroundings of the building. It has been decided, therefore, to do this by outside contract and it is hoped that the coming year will see the work accomplished.

Field Experiment Station.

Of the total of 38 acres felled, some 12 acres have been placed under new experiments and a further 5 acres of new land have been brought into the genetics experiments. This brings the total area of experimental plots to about 265 acres. Commercial air spraying against wattle bagworm was carried out on 77 acres, in part to facilitate stripping of infested mature plantations and in part to protect a very young plantation which could not be hand-picked in time to prevent serious damage.

Although the fall in the price of wattle bark in February somewhat reduced the income from that source, the farm again showed a substantial working profit.

Trial diggings have been made to find a suitable site for a dam on the lower part of the farm and plans are being prepared for re-housing the native labour nearby. It is intended that this latter project shall form a demonstration unit of various types of approved dwellings.

ADMINISTRATION AND FINANCE

After four years valued service on the Committee of Control as alternate to the Principal, Dr. A. R. Saunders resigned in March on his transfer to the new Faculty of Agriculture in the University of the Orange Free State. He has been succeeded on the Committee by Mr. H. H. Cornell, Director of the Natal Region of the Department of Agriculture and a member of the Natal University Council. Four ordinary meetings of the Committee were held during the year. Dr. Saunders was again nominated, with Mr. C. E. Lack as alternate, as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

There have been no material developments in the discussions relating to an increased Government grant in support of the Institute, and the grant remained unchanged at £5,000 per annum. From the 1st April, 1957, however, the Government's interest in the Institute has been exercised through the Department of Agriculture instead of the Department of Forestry.

Expenditure and Income.

For the first time in the history of the Institute, and quite unusual for any research organization, expenditure during 1956–57 was less than in the previous year and over £2,400 below the estimate. This is to be regretted, for the explanation lies in the persistence of unfilled staff vacancies for which provision had been made. This involuntary saving more than compensated for the extraordinary expenditure on renovations and on the visit of the Silviculturist to Australia and New Zealand.

The heavy cost of vehicle maintenance has led to a revision of replacement policy and in future, vehicles will be disposed of at an earlier stage, before repair bills become excessive. It is worthy of note that while direct expenditure on research rises steadily, administrative costs have remained static or even decreased slightly for several years.

Fees for analytical services, at £71 8s. 0d., were much below those in the previous year.

The summarized statement of Expenditure and Income for the period 1st September, 1956, to 31st August, 1957, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1956, to 31st August, 1957

Expenditure	£	s.	d.	*Income*	£	s.	d.
Research and Administrative Staff Salaries ..	18,175	10	9	S.A.W.G.U. Grant ..	18,561	2	11
Travelling and Subsistence	2,223	4	0	Department of Forestry Grant	5,000	0	0
Laboratory and Office Equipment and Maintenance	1,226	3	9	Analytical Services ..	71	8	0
Library	280	18	6	Sale of Wattle Bark ..	19	9	6
Printing and Stationery ..	273	13	6				
General Administration	748	1	11				
Building Maintenance ..	670	14	0				
Building Additions	53	14	0				
	£23,652	0	5		£23,652	0	5

STAFF

Mr. E. R. Vaughan, an Honours graduate in Mathematics of the University of Natal, was appointed in July, 1957, to the post of Statistician (Biometrician) in the Institute. Protracted negotiations for the appointment of a Plant Physiologist have not yet been concluded, while no progress whatsoever has been made towards filling the vacant posts of Assistant Entomologist and Assistant Silviculturist. Lack of the former has imposed a heavy burden upon the Entomology Section throughout the year and seriously interfered with research investigations. The failure to secure an additional Silviculturist has thus far frustrated the plan to institute a series of field experiments in the northern wattle districts.

Mr. C. G. Gordon-Gray, of the Chemistry Section, is to be congratulated on the conferment of the degree of M.Sc. in Chemistry by the University of Natal.

Two Junior Technical Assistants resigned during the year. Mr. J. H. Scheltema left the Silviculture Section in January, 1957, and was replaced by the appointment of Mr. I. S. Alexander in May. Mr. R. R. Hawkins, who left the Entomology Section also in January, 1957, to undertake a year's full-time military service, was succeeded in March by Mr. J. A. Hunt. Mr. J. A. Nagle held a temporary post as Technical Assistant in the Entomology Section from October, 1956, to February, 1957.

Two additional Africans have been appointed to assist in preparing bagworm material for the large-scale isolation of virus concentrates to be used in spraying experiments.

Mrs. P. M. Allison again deputized for Miss Smith during the latter's absence on sick leave and annual leave in September and October, 1956. One Natal University student was employed as a temporary assistant for three months in the summer vacation to help with field work in the Entomology Section.

No application was received for the Wattle Research Institute Scholarship for 1957.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

The number of advisory letters written (262) showed a small increase over the previous year, with those relating to insects and pest control (123) again amounting to very nearly half the total. Silviculture proper (31) accounted for a lower proportion than usual, but there was a very marked increase in the number relating to values, economics, and prospects and in enquiries concerning publications. Natal was, as usual, the main source of enquiries, but sixteen countries outside South Africa appear in the list, including for the first time Italy, Japan, and the Philippines.

The Silviculturist paid 37 visits to growers' plantations, including an extended tour of the northern areas of Natal and the Eastern Transvaal. The Entomologist's 78 advisory visits were largely determined by the incidence of wattle bagworm and thus covered the area from Pondoland in the south to Vryheid and Zululand in the north. In addition, this Section paid many visits to growers' plantations in connection with the bagworm survey and the preparations for commercial spraying.

There was an increase in the number of visitors to the Institute to about 120, due mainly to a visit by some 40 members of the South African Chemical Institute in July and to the University Open Day in August. Included among visitors from outside the Union were Dr. T. White, Director of Research in the Forestal Land, Timber and Railways Company, Limited, Mr. W. G. Harvey, of Harvey & Sons, Limited, Mr. N. W. Hudson, Conservation Research Engineer, Federation of Rhodesia and Nyasaland, and Professor S. H. Harper, of the University College of Rhodesia and Nyasaland. Others came from England, Finland, Germany, Kenya, Moçambique, Southern Rhodesia, and Tanganyika.

The Annual Farmers' Field Day at Bloemendal was again held in two sections on the 14th and 15th March. On the first day, the attendance at about 65 was well up to expectation, but on the second day, inclement weather kept away all but a handful of visitors. Two other general visits were arranged for immediately before and after the South African Wattle Growers' Union Congress in November; some 35 growers attended. Several other parties, including a group of agriculture students, and a number of individuals visited the Field Station during the year. Notable among the visitors were the members of the Department of Agriculture Agroclimatological Committee, who paid a special visit to the run-off and erosion experiment.

The Institute has again been called upon for advice and information by various public authorities and institutions, among them the Union Government Departments of Agriculture, of Education, and of External Affairs, the South African Council for Scientific and Industrial Research, the South African Institute for Medical Research, the Natal Parks Board, the Argentine Legation, the Food and Agriculture Organization of the United Nations, and the Department of Agriculture in Malaya. Several industrial organizations and two commercial banks have also been advised on technical and economic questions.

The Institute collaborated with the Division of Economics and Markets in the Department of Agriculture in planning the economic survey of the wattle industry called for by the Minister of Agriculture. Assistance was given in compiling the questionnaire and in selecting the sample of growers to be interviewed. Help was also given in a timber survey initiated by the Industrial Economics Section of the Council for Scientific and Industrial Research.

The Institute continued its co-operation with the Division of Film Services in preparing the two-reel film on the wattle industry for the Union Department of Education. Filming took place in November and Mr. Sherry was in almost continuous attendance as technical adviser for all the silvicultural and plantation scenes. At a later stage, he advised on the cutting and editing and, with other members of the Institute staff, assisted in preparing the commentary. The first print of the finished film was

presented to the Institute and is now available for general use. Further copies of the film will be used in the schools and will be made available for use overseas by the State Information Office.

Analyses of wattle bark samples in co-operation with the Government Bark Inspector were continued, though on a considerably reduced scale as compared with the previous year. A few samples of bark and extract were examined for private growers, manufacturers, and export agencies. In view of the pressure of experimental samples awaiting analysis, this reduction in outside work is unreservedly welcomed.

The Entomology Section again carried out the annual bagworm survey on behalf of the Wattle Growers' Union and subsequently directed and supervised the 1956 commercial spraying campaign. The scale of these operations is indicated by the fact that Institute vehicles travelled over 10,000 miles during the year on this work alone. The demands thus made upon the time of the Entomology staff unfortunately necessitated the suspension of several research projects.

At the request of the newly formed Inter-African Phytosanitary Commission, Dr. Ossowski prepared a Report on "Wattle Insect Pests of Major Importance in Southern Africa". He also contributed to a list of common and scientific names of insects being prepared by the Agricultural Terminology Committee of the Department of Agriculture. At the invitation of the editors of the "Anzeiger für Schädlingskunde", Dr. Ossowski wrote, in German, an article on the insect fauna of wattle in South Africa for a special review number of the journal.

Several University of Natal students working on research projects have made use of the Institute's facilities, particularly in the way of literature and information, and have been advised by individual members of the staff. Descriptive literature and demonstration specimens have been sent on request to a number of schools and colleges.

Committees, etc.

There has been an appreciable increase in committee work during the year, particularly in that falling upon the Director and Mr. Sherry.

The Director attended the Annual Meeting of the Research Advisory Council of the Leather Industries Research Institute held in Grahamstown in June, 1957. One meeting of the Wattle Technical Committee was held during this visit and another, attended also by Dr. Martin and Mr. Gordon-Gray, in November, 1956.

The Director attended all the meetings of the General Committee and one meeting of the Executive Committee of the Wattle Growers' Union. On behalf of the Union, he carried through the negotiations leading to the inception of work on alternative uses for wattle tannin by the Paint Industries Research Institute under a grant from the Union. He also arranged for preliminary tests to be carried out in the C.S.I.R. Corrosion Laboratory in Cape Town. Dr. Shaw was present as Chairman at two meetings of the Steering Committee for the Wattle Timber Research Fellowship and served as the link between the Union and the National Chemical Research Laboratory. In the course of this work, he visited a number of timber-consuming industries with the Fellow to discuss potential uses of wattle wood.

Along with Mr. Sherry, the Director served on the Union's Field Experiment Station Committee and the Royal Show Exhibit Committee, and with Dr. Ossowski on the Pest Control Committee. Dr. Shaw (convener) and Mr. Sherry were also members of a special sub-committee appointed by the Union to report on facilities available in Natal for education in forestry.

Mr. Sherry continued his work on Fire Protection Measures and Fire Legislation, in which connection he took part in protracted correspondence and discussions with officers of the Division of Soil Conservation and Extension. He also served for another year on the Committee of the Botanic Society of Natal.

Conferences, Lectures, Meetings, etc.

The Director attended a symposium on Wood Chemistry arranged in July by the South African Chemical Institute.

Mr. Sherry addressed a number of Soil Conservation District Committees and local Farmers' Associations in connection with the proposed proclamation of a Fire Protection Area. He was the principal speaker at a Farmers' Day arranged by the Agricultural Extension Officer in the south-eastern Transvaal. Following the severe damage caused by a heavy snowstorm in July in northern Natal, Mr. Sherry inspected the area and subsequently addressed a growers' meeting on the treatment of the damaged stands. He also attended the inaugural meeting of the South African Timber Growers' Association as an observer.

Early in August, 1957, Mr. Sherry left to attend the Seventh Commonwealth Forestry Conference in Australia and New Zealand. Immediately before and for some weeks after the Conference, he will visit the parts of south-eastern Australia and Tasmania where wattle is found to study the tree in its natural habitat and to search for promising breeding material.

LIBRARY

After a rather lean year in 1955–56, there was a considerable increase in the accession of new books in the Library. The addition of 26 brought the total to 283, while 42 bound volumes of periodicals were added making 322 in all. There was a further increase to 271 in the number of bulletins, reprints, etc. received and the total now is 2,209.

Thanks are due to the Council for Scientific and Industrial Research and the South African Lumber Millers' and Shook Manufacturers' Association for the gift of copies of "Timber Resources and Timber Utilisation in South Africa".

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To Dr. P. H. B. Talbot, of the Division of Botany, Union Department of Agriculture, for assistance in identifying and naming several species of forest fungi.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To Dr. K. M. Smith, the Director of the Plant Virus Research Unit at the Molteno Institute of Biology and Parasitology, University of Cambridge, for guidance and help in insect virus research.

To Mr. J. Gibson, of the Windy Hill Wattle Company, and his field staff for untiring assistance during the organization and execution of the aerial spraying experiment.

To the Division of Film Services of the Union Department of Education, Arts and Science for a colour print of the film "The Wattle Industry in Natal".

To Professor A. A. Rayner, of the Faculty of Agriculture in the University of Natal, for advice on statistical problems.

To the many growers who have provided facilities for conducting experiments in their plantations and who have co-operated in reporting the incidence of wattle insects and in sending material for the Institute's insect collection.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

(*a*) Experiments S.1 at Broadmoor (Wartburg district), S.3 at Bloemendal (Pietermaritzburg district), and S.5 on the Clan Syndicate Estate (Albert Falls district) were re-measured during the year. Analysis of these measurements showed no change in the suppression relationships found between plots at the previous measurement of these experiments last year.

(*b*) Experiment S.10 at Bloemendal, in which densities ranging from 100 to 900 trees per acre at intervals of 100 trees are being compared, was measured in February, 1957, at four years of age. Analysis of these measurements showed that plots at 900 trees per acre had a smaller mean breast height diameter than plots at 500 per acre and less, plots at 700 had a smaller diameter than those at 300 per acre and less, and plots at 600 per acre a smaller diameter than plots at 200 and less. All these differences were significant at the five per cent. level.

2. Effect of Different Methods of Weed Control upon Growth.

Experiment S.31 was laid down at Bloemendal in October, 1955, at a row espacement of nine feet to compare the effect of hoeing, disc-harrowing, and mowing weed growth upon the rate of growth of wattle. The treatments were as follows:

A. Weeds hoed as necessary over the full width of the inter-row spaces up to the time the trees received their first spacing, thereafter on a central six-foot strip until the trees averaged four feet in height. Three hoeings were carried out.

B. Weeds removed by disc-cultivation as necessary until the trees averaged four feet in height. Plots were cultivated three times.

C. Weeds removed by disc-cultivation as necessary until the trees averaged ten feet in height. Plots were cultivated five times.

D. Weeds removed by disc-cultivation as necessary until the trees closed canopy. Plots were cultivated seven times.

E. Weeds mown as necessary until the trees closed canopy. Weeds were mown five times.

Heights were measured at sixteen months from planting, immediately after the plots had been thinned to 700 trees per acre, and breast height diameters were taken five months later. The maximum differences in mean height and mean breast diameter were 1·5 feet and 0·2 inches respectively, and neither was significant. It may be assumed, therefore, that growth of trees up to about two years of age has not been materially affected by the method of weed control.

A careful record was kept of all operations carried out in each series of plots, and it was thus possible to calculate the cost per acre of weed control with the various methods used. The record of operations, with their respective costs, is set out in the following table:

Operation	Labour units per acre					Implement hours per acre			
	A	B	C	D	E	B	C	D	E
Hoeing	27·5	—	—	—	—	—	—	—	—
Disc-cultivation	—	—	—	—	—	4·5	7·5	10·5	—
Mowing	—	—	—	—	—	—	—	—	12·5
Carrying out thinnings at 6′..	—	—	0·5	0·5	0·5	—	—	—	—
Hand-pulling regrowth	0·25	1·0	2·5	1·5	—	—	—	—	—
Carrying out thinnings at 12′	—	—	—	0·5	0·5	—	—	—	—
Total work units	27·75	1·0	3·0	2·5	1·0	4·5	7·5	10·5	12·5
Costs in shillings	111·0	4·0	12·0	10·0	4·0	31·5	52·5	73·5	25·0
Total costs in shillings per acre	111·0	35·5	64·5	83·5	29·0	—	—	—	—

It will be noted that mowing has proved the cheapest method of weed control, with disc-cultivation until the trees reached a height of four feet costing only a little more. If differences in growth resulting from different methods of weed control do not increase as the trees grow older, it is probable that, apart from its cheapness, mowing will prove the most satisfactory because the risk of mechanical damage to the trees is much less than with disc-cultivation. The high cost of hoeing was due to the extremely heavy growth of grass in this plantation and might have been reduced somewhat had it been possible to use six-foot row espacement in the hoed plots, as would normally be the case in plantations where weeds are controlled entirely by hoeing.

An interesting point which has emerged from this costing study is the variation of costs of hand-pulling regrowth over the five treatments. In the mown plots, where no soil disturbance occurred, no hand-pulling was necessary, and in the hoed plots the cost of hand-pulling was very low. In the disc-cultivated plots, the cost of hand-pulling was highest in those where cultivation continued until the trees were ten feet high, rather lower in the most heavily cultivated plots, and lowest of all in the plots cultivated only three times, where the least soil disturbance took place. The relatively low cost in the case of the D treatment is thought to be due to the fact that cultivation operations were continued until the inter-row spaces were sufficiently shaded to discourage vigorous seedling regrowth.

Observations on these plots will be continued to determine the effect of the various treatments on the incidence of gummosis and wood-rot infection. The plots will be re-measured at intervals to determine whether any changes in the effect of weed-control treatments upon tree growth appear at a later stage in the life of the stand.

3. Economic Study on Intercropping of Wattle.

Experiment S.39 was laid down at Bloemendal in February, 1957, to determine the economic value of crops other than maize as an intercrop in newly re-established wattle stands, having regard also to the effect of the intercrop on the growth of the wattle. This study was based on the possibility of utilizing the high nitrogen content of wattle soils to produce a food crop during the period before the root system of the newly established wattle stand could occupy the inter-row spaces.

Intercropping of wattle with maize has been practised for many years, but little attention has been paid to the possibilities of other food plants for this purpose. The main disadvantages of maize as an intercrop for grain production are the necessity for sowing before December, which complicates the handling of the timber from the previous wattle crop, and the tall growth, which exerts a prolonged and usually deleterious shading effect on the wattle seedlings. In order to avoid these disadvantages, it was decided to include in the trial only relatively low-growing intercrops which could be established fairly late in the season when the timber had been extracted. A site on which wattle had been re-established at six-foot row espacement had perforce to be used for the experiment,

although it was realized that a wider row-espacement, permitting the use of tractor-drawn implements for breaking up the soil, might have been preferable. Treatments were as follows:

A. No intercrop. Weed-growth between rows hoed once.

B. Oats sown broadcast on a central strip three feet in width between the rows. No hoeing.

C. Peas sown in two drills three feet apart, each eighteen inches away from a tree row. Weed growth between rows hoed once.

D. Swedes sown in three drills eighteen inches apart, the outside drills each being eighteen inches away from a tree row. Swedes thinned by hand-pulling and weed growth between rows hoed once.

The wattles in all plots were fertilized with superphosphate at the rate of 200 lb. per acre under the seed. The intercrop received a further dressing of superphosphate at the rate of 220 lb. per acre.

At five months of age, immediately after the intercrops had been harvested, the mean heights of the trees and the yields of the crops were as follows:

Treatment	Mean height of wattles (feet)	Yield of intercrop (long tons per acre)
A. No intercrop	1·28	—
B. Intercropped with oats	1·57	1·64
C. Intercropped with peas	1·51	Nil
D. Intercropped with swedes	1·18	6·37

Standard error .. .. 0·083
Significant difference (P=0·05) .. .. 0·29

Height growth in plots intercropped with oats was significantly better than in plots without intercrop and in those intercropped with swedes. Trees in the plots intercropped with peas were also significantly taller than in those intercropped with swedes.

It is difficult to place a cash value on fodder crops such as green oats or swedes, which are normally consumed by stock on the farm, but it is reasonable to assume that such crops would be worth at least thirty shillings a ton.

On this basis, the intercropping with oats was economically satisfactory in that the value of the intercrop covered the cost of seed oats, planting, and fertilizer and, in addition, no hoeing of the wattles was necessary. The growth of the wattles was not adversely affected, and may even have benefited.

Although the value of the swede intercrop was considerable and greatly exceeded the cost of seed, planting, fertilizer, and thinning, this intercrop may have affected the growth of the wattle adversely, and in course of being harvested may also have resulted in some injury to the roots of the latter. If two rows of swedes instead of three had been planted between the rows of wattle, the effect on the growth of the trees might have been less. A further trial will be undertaken next year to check this point.

The growth of wattles intercropped with peas did not suffer, but the intercrop was a complete failure.

The fact that the height growth of the control plots with no intercrop was poorer than that in the plots intercropped with oats was probably attributable to the additional fertilizer received by the latter. Further observations will be made both on the subsequent growth of the wattles and on the incidence of gummosis and wood-rot infection.

(b) GENETICS AND PLANT BREEDING

1. Interspecific Hybrids.

(*a*) *Green and black wattle hybrids.* The analysis of leaf characters in the F_2 and back-crossed families was completed and the results have been summarized in a paper which has been accepted for publication elsewhere. (Moffett and Nixon, 1958.)

It was concluded that since characters of economic importance are likely to behave in a similar manner to leaf characters, which are polygenic in inheritance, the possibilities of combining desirable economic characters of the two species in a hybrid strain could be deduced. Green wattle is generally considered to be hardier than black wattle under adverse conditions, to be more resistant to bagworm attack, and to produce straighter stems. None of these characters is very clearly defined, and because of the blending nature of polygenic inheritance, they are difficult or impossible to follow in hybrids without making elaborate tests. The behaviour of the leaf characters showed that, as happens with most species hybrids, there is a strong tendency for characters from the same parent to remain associated in the progeny. By analogy, it would seem improbable that, for example, the tannin quality of black wattle and the bagworm resistance of green wattle could be combined to give the full expression of each of these characters; only by sacrificing some of the quality of the black wattle and some of the resistance of green are these two characters likely to be combined. Since, however, green wattle is not immune to bagworm attack, but only more resistant than black, any lowering of the resistance, or even an increase in the acreage of green wattle grown compared with black in the wattle area, would doubtless be met by the bagworm evolving a strain which could damage green wattle, or hybrids derived from it, just as badly as it now does black. It would seem that, unless clear-cut characters of economic importance are discovered in green wattle, it would be unwise, at present, to embark on an extensive breeding programme involving the two species.

(*b*) *Black wattle* x Acacia baileyana. Further examination of the presumed F_2 from this hybrid (*Annual Report* 1955–56) led to the suspicion that some outcrossing had taken place, either with green wattle or with green x black wattle hybrids which may have flowered unnoticed in the vicinity. A second attempt was made to produce F_2 seed under controlled conditions, but the hybrid trees proved to be highly self-sterile under bags and no seeds were produced from some 30 inflorescences covered by bags.

2. Black Wattle Selfed.

The programme of producing inbred lines of black wattle with a view to subsequent recombination to produce vigorous hybrids was continued. Twenty-five trees were selected and bagged in selfed families (S_1) of black wattle planted in 1952. Although the plantation was heavily attacked by bagworm, spraying of the selected trees with Toxaphene was effective in preventing destruction of the young pods.

3. Progeny Testing of Selected Trees.

During the season under review, the emphasis was again on the selection of trees in black wattle and the testing of their genetic potential by means of progeny trials. The following summarizes very briefly the work carried out:

(*a*) *Progeny trial planted in* 1956. During the summer of 1955–56, 81 trees were selected and open-pollinated seed collected from them for the sixth of the series of progeny trials. The young trees from this seed were planted out at Bloemendal on the 19th December, 1956.

Following treatment of the soil with a BHC insecticide before planting, and the netting of the area against hares, a good initial stand was obtained. During June, 1957, however, many of the trees were damaged by frost to a height of some eight inches from

the ground and some of the smallest were killed. The full extent of this frost damage cannot be assessed until it is seen to what extent the trees recover.

The 81 families were arranged in a lattice square with three replications. By reducing the number of replications to three and, at the same time, slightly decreasing the plot size, the 81 families were fitted in approximately the same area of land as had been used for 49 families in the previous year. It was expected that by reducing the replications, some accuracy in the comparisons would inevitably be lost, but it was felt that for preliminary screening, any loss of accuracy would be more than compensated by the larger number of trees tested.

The trees were scored for height during July, 1957, when their average height over the whole experiment was 2·5 feet. Differences between the families were highly significant (P=0·01). A comparison of the lattice square design and randomized blocks showed that the three replications of the former were more efficient than four of the latter.

(*b*) *Progeny trial planted* 1955. The fifth progeny trial planted during December, 1955, was scored in March, 1957, for height, forking of the stem, and gummosis. This trial has by far the most even stand of all trials to date and, in addition to the characters scored in detail, many other striking differences between families were noted. Amongst these were differences in the straightness of the stem, the number of lateral branches, leafiness, and the colour of the foliage. Pinnule shedding, a phenomenon frequently observed in young plantations in the autumn and thought to be due to environment, was found to be much more prevalent in one family than in the others and, therefore, presumably to be in part, at least, genetical.

The trees, which were fifteen months old at the time of scoring, averaged fourteen feet in height with a range between families of 12·7 to 15·2 feet. Differences in mean height between the families were significant at the one per cent. level.

By inspection, the families appeared to differ in the number of trees having forked stems, but on scoring and analysis, the differences did not reach the level of significance. Differences between families may, however, have been obscured by the grouping of two types of forking. Forking from the base, which gives rise to two or more stems, is evidently a different character from forking or branching higher up the tree. The analysis of the separate figures for these two types of branching has not yet been completed.

According to the increasing severity of the attack, five grades of gummosis were recorded. For the purpose of preliminary analysis, however, degrees of attack were not taken into account, comparison being made between the percentage of trees having gummosis, however slightly, and those which were completely free from it. On this basis, the differences between families were significant at the five per cent. level.

With the exception of one tree which was taken because it had an extremely severe attack of the disease, all the trees selected as parents of this progeny trial were chosen as being free from gummosis. The diseased tree was included to determine whether the susceptibility of the parent to gummosis is passed on to its progeny. The family from this tree had, in fact, the highest degree of gummosis, 72 per cent. of the trees being affected, compared with 11 per cent. in the family with the lowest incidence and an average of 36 per cent. over the whole experiment. On the other hand, a number of the other selected trees subsequently developed gummosis, and examination showed that the parent of a family having 71 per cent. gummosed trees was not as badly attacked as the parent of a tree having only 14 per cent. of the trees affected. The results are, therefore, inconclusive.

(*c*) *Felling of selected trees.* Of the trees selected for progeny testing, the felling and tannin analysis of the bark of 64 from which air layers had been struck was undertaken by the Chemistry Section. These trees had a mean diameter of 9·5 inches, with a range of 5·4 to 14·9 inches, and a mean strippable bark weight of 128 lb., the range being from 38 to 251 lb. per tree. Wide variation in the percentage of tannin also occurred, the mean being 43 per cent. and the range from 37 to 49 per cent. Although, in general,

there appears to be a positive correlation between the diameter of a tree and the percentage tannin in its bark, no such relationship existed in this particular group; in fact, the tree with the highest tannin content in its bark had a diameter of 8·8 inches, which is well below the mean of the group. It is evident from this group of trees that diameter as a guide to tannin content is unreliable.

Families derived from a number of these selected trees (Nos. 1—25) had been sampled for tannin, when 3½ years old, by taking pellets of bark at intervals up the stem, extracting in cold water, and analysing by means of the spectrophotometer (*Annual Report* 1952–53). While this method of analysis gives a good estimate of the relative percentage of tannin in samples, the actual percentage is lower than that given by the official hide-powder method. For comparisons between families, however, it should be satisfactory.

There was no indication that a parent tree having a high percentage tannin in its bark produced progeny with a higher mean tannin content than did a parent tree with a low tannin content. Subsequent work by the Chemistry Section has shown, however, that the method of sampling the trees was probably inadequate, and the failure to establish any correlation between the tannin content of the parent and that of its offspring may be due to faulty sampling technique.

(*d*) *Seed Orchards.* A number of trees have now been located whose progeny are considerably better than average for vigour or for the degree of resistance to gummosis. Two groups of rooted air layers from these trees have been planted with a view to establishing seed orchards. In the first group, layers from ten trees whose progeny were significantly better than average in vigour have been interplanted. In this group, while selection has been based mainly on vigour, no tree showing a higher than average gummosis attack has been included.

In the second group, selection has been mainly for gummosis resistance, rooted air layers from the parents of nine families which had a very low incidence of gummosis being interplanted. The vigour of these families was at least average.

A third group of layers from the parents of families which have shown the best combination of vigour and gummosis resistance has been prepared for planting.

4. Vegetative Propagation.

Of the 81 selected trees which had been air layered during the previous season, approximately half were on the eastern border of the experimental farm and the remainder on the west side. For some unexplained reason, air layers on the trees on the eastern side of the farm were an almost complete failure, while those on the west side gave the normal degree of success.

Further work was started to try to improve the air layering technique both from the point of view of obtaining a higher "strike" and from that of obtaining layers from difficult trees.

A further attempt was made to root cuttings as an alternative to propagation by air layering. Cuttings from different types of wood from the same tree were placed in tins and the whole enclosed in a polythene bag to maintain a high humidity. Many of the cuttings remained alive for nearly three months and some produced shoots and small leaves, but none was found to show any sign of root formation or even callusing. Air layers placed on the same tree from which wood for cuttings had been taken produced roots within this time.

5. Tetraploidy.

The small isolated plantation of tetraploids planted out in 1952 reached flowering stage. The plantation was checked and all diploid or doubtful tetraploid trees removed so that only known tetraploids remain to interbreed.

Tetraploid trees have, on the whole, made slow growth compared with diploids, and many have misshapen tops. Scoring for bagworm damage in this block showed that tetraploids were more heavily attacked than diploids, 83 per cent. of the former and

62 per cent. of the latter being more or less defoliated. In another part of the experimental farm, where younger diploid and tetraploid trees are growing side by side, the very much heavier bagworm attack on the tetraploids was again most noticeable. It is not known whether the heavier attack on tetraploids is due to their being more palatable to bagworms, or whether it is a question of the size and time of flushing of the trees.

REFERENCE

Moffett, A. A. and Nixon, K. (1958). Genetical studies in Acacias. II. Leaf characters in hybrids between black and green wattles. *Heredity*, **12**, (in the Press).

(c) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.* All the trees in these experiments were measured, with no change in the general indications. Once again, superphosphate gave significant increases in estimated yield on all sites, as did lime. Potash gave a significant increase on shale only. The results are given below:

Mean bark weight in relation to treatment
(No Treatment=100)

Soil-parent material	Nitrogen	Phosphorus	Potash	Lime
Table Mountain sandstone	99	116**	105	108*
Shale	100	114**	111**	107*
Dolerite	103	110**	103	109*

** Differences significant (P=0·01)
* Differences significant (P=0·05)

(*b*) *Different forms of phosphate.* There are no significant differences between the estimated yields of bark with different forms of phosphate.

Treatment	On dolerite	On shale
Superphosphate	103	105
Super-raw (3:1)	100	102
Langfos	98	97
Moroccan rock	99	98
Calcium metaphosphate ..	101	98

(*c*) *Quantity of superphosphate and method of application.* The results of this year's measurements indicate that there is nothing to choose between methods of application of fertilizer. Quantities applied are still significant and the optimum economic dressing is between 200 and 400 lb. per acre. In the table below, estimated bark weights have been used as the basis of calculation instead of tree heights as in previous years. The graph giving the results of treatments C and D is still based on height measurements. The treatments are:

A. Half under the seed before sowing; remainder between the lines one year later.

B. Half in bands on either side of the seedling lines at first thinning; remainder between the lines one year later.

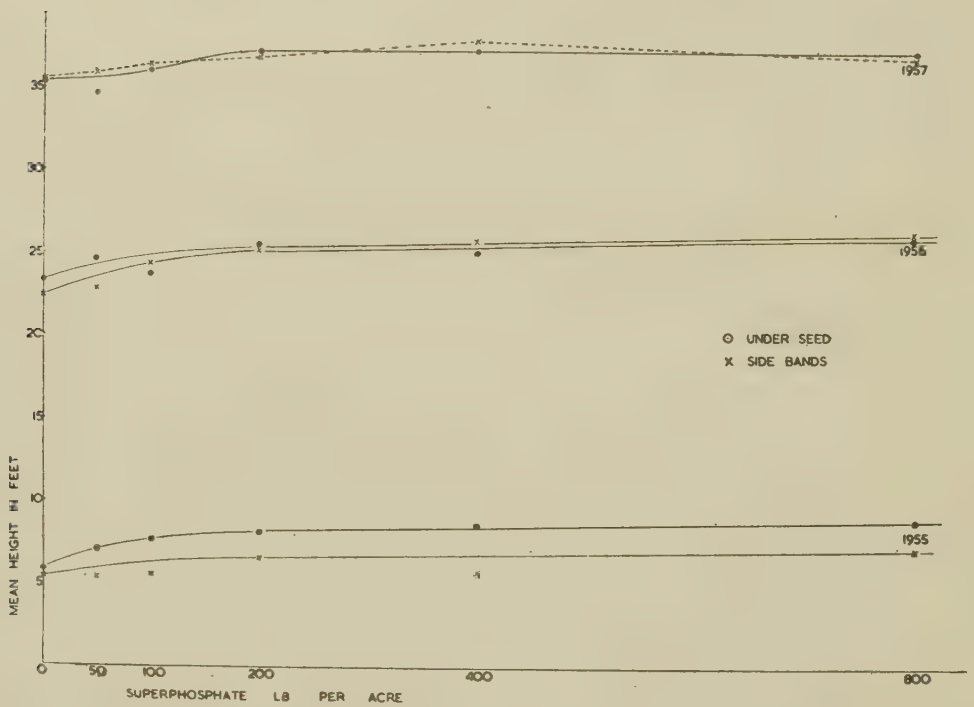
C. All under the seed before sowing.

D. All in bands on either side of the seedling lines at first thinning.

Estimated bark weight in lb. per tree

Treatment	Superphosphate lb./acre						
	0	50	100	200	400	800	Mean
A	12·63	13·25	13·25	14·38	14·93	15·15	13·93
B	12·40	12·65	13·48	13·43	15·38	15·40	13·79
C	12·95	12·30	13·55	14·65	15·33	15·73	14·09
D	13·00	13·00	13·13	14·48	15·45	15·70	14·13
Mean	12·75	12·80	13·35	14·24	15·27	15·50	13·99

	Treatment	*Amount*
Standard error	0·453	0·320
Significant difference (P=0·01) ..	1·47	0·85



(*d*) *Gummosis.* Counts of gummy trees on all the fertilizer experiments have revealed no significant differences due to fertilizer application.

2. Bark Analysis.

(*a*) *Routine analyses.* About 750 bark samples were analysed during the year. Some 31 of these were submitted by the Government Inspector of Wattle Bark, whose visual estimates were again reasonably good.

Most of the remainder were in connection with the investigation of sampling methods. A number of trees specially selected as "mother" trees by the Geneticist were also dealt with.

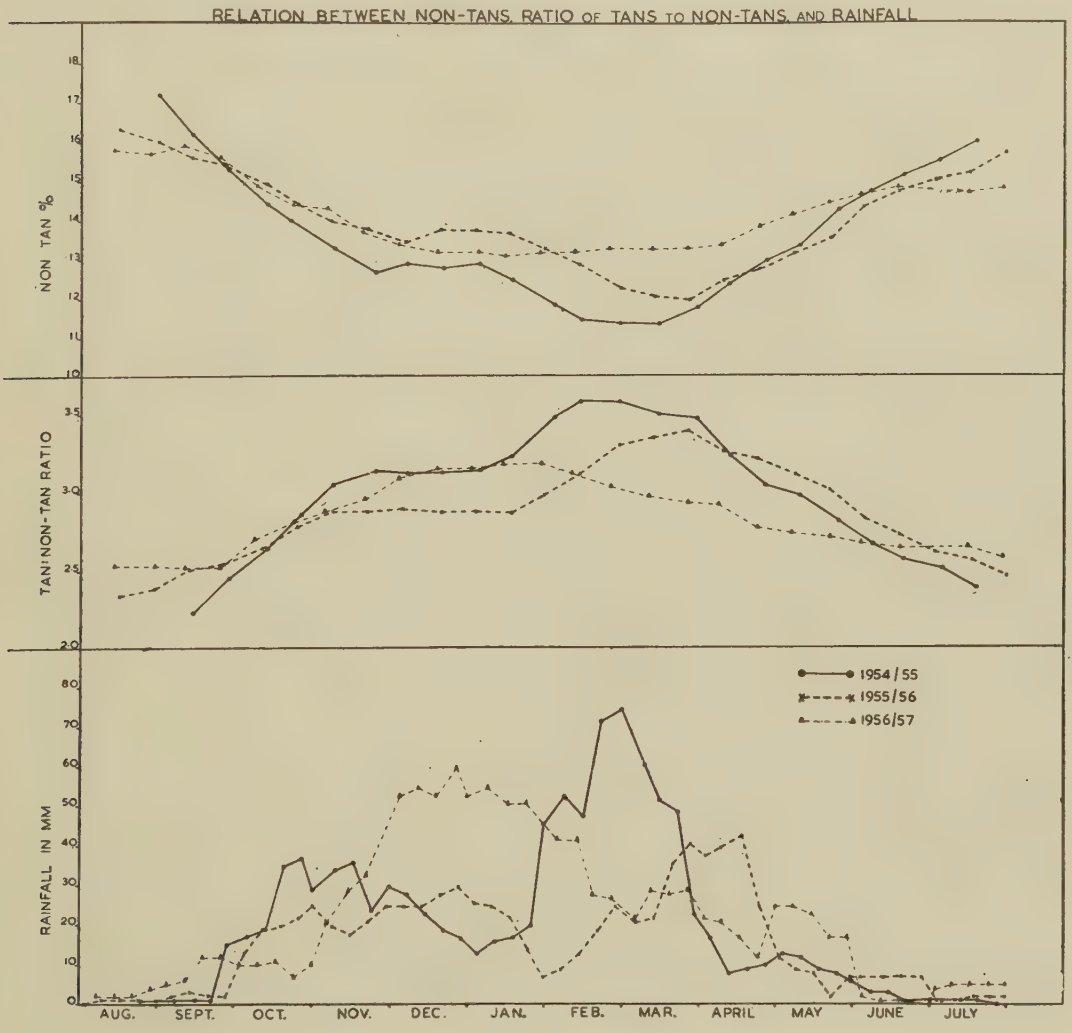
(*b*) *Tree and plot sampling.* Field work on sampling methods has been continued. Unfortunately, analysis of pellet samples has been delayed by the late arrival of a new mill suitable for grinding such small samples. The mill was delivered and set up in July and a start has been made on the grinding and analysis of the large number of samples taken in the course of this work.

3. Seasonal Effects on Extractives in Wattle Bark.

Variation in non-tan content. In 1954, some 400 trees in an ordinary commercial stand were numbered and set aside for this experiment. Since then, groups of five trees, selected by random numbers, have been felled and stripped at fortnightly intervals. The bark was shade-dried, chopped, ground, and analysed. Weekly readings from a rain gauge, set up near the plot, were also taken. Statistical examination of the results has shown a significant correlation ($P=0{\cdot}001$) between percentage non-tans and rainfall, whereas the relation between tannin percentage and rainfall was not quite significant at $P=0{\cdot}05$. The figures for non-tans, the tan to non-tan ratio, and rainfall are summarized in the graph below, where five-point smoothed means are plotted against time.

It is evident that non-tan percentage decreases with increased rainfall and consequently the tan to non-tan ratio varies directly with rainfall. This is particularly clear in the first two years, where a drier period in the middle of the wet season is reflected in the other curves. In the third year, where rainfall was well distributed, the non-tan percentage never reached the low levels of the two previous years. By this time, however, the tree stand was thin and the competition for water not so severe.

In the 1956 dry season, three plots were spray irrigated at a rate of two inches per week and another three plots were kept dry. Here again, the "wet" plots were significant-



ly lower ($P=0{\cdot}05$) in non-tan percentage than the "dry" ones. Whilst it is comparatively easy to establish this empirical relationship, it is more difficult to find a reason for it. It will be shown in the next section that the non-tans contain sugars in addition to mineral salts and polyphenols. The wet, warm season is that of the greatest physiological activity of the tree, and growth is at its maximum whilst the non-tans are at their minimum. It may be that the sugars and minerals are translocated to the zones of greatest activity, i.e. the crown, branches, and twigs, during the growing season and restored to the bole during dormancy. There may be a number of factors involved in addition to rainfall, though that appears to be the dominant one.

4. The Chemical Composition of Non-Tans.

Following directly on the work mentioned above, in which it was shown that seasonal fluctuations occurred in non-tan percentage, an investigation into the composition of the non-tan fraction of bark aqueous extract was undertaken.

It has recently been shown spectrophotometrically that the non-tans contain appreciable amounts of polyphenols in addition to the sugars and related substances already known to be present. It is not known, however, whether these polyphenols undergo constitutional changes with season, as has been reported for tea polyphenols, or, if they do change, whether they remain as non-tan substances or become part of the tannin complex. A quantitative as well as a qualitative analysis of non-tans from the bark harvested at fortnightly intervals may give some information on this question. Further, a knowledge of the sugars, etc. and the polyphenols, and their seasonal variation, may assist materially towards an understanding of the mechanism of the formation of the tannin fraction.

At the outset, this investigation is concerned solely with the isolation and identification of the various components in the non-tans of the aqueous extract from a single bark sample (Bloem. 463) collected in the dry season when non-tan content was highest. Once these have been determined both qualitatively and quantitatively,the fortnightly samples of bark will be investigated.

The extraction of 100 grams of bark in a Procter bath was shown to be comparable, in the efficiency of extraction, with routine analytical procedure. The tannin in the two litres of extract obtained thus was removed by precipitation with lead acetate and the resulting non-tan solution taken to dryness under reduced pressure. Although the non-tans so obtained probably differ from those which would result from shaking the extract solution with hide powder, it was considered permissible to employ this method because of its greater convenience. When all the non-tan components have been identified, a comparison with hide powder non-tans can be made.

The non-tan solids were then chromatographed on a charcoal column and the column eluted first with water (1 litre), then with 5% ethanol (1 litre), and finally with 15% ethanol (1 litre). The filtrate was collected in 100-ml. portions. The column removed the polyphenols completely and separated the sugar fraction into mono- and di-saccharides.

The total solids in the 100-ml. portions collected from the column were estimated by evaporating 5 ml. of the solution to dryness. The remaining 95 ml. were then passed through ion exchange resins and evaporated to dryness under reduced pressure. The residues obtained were investigated by column and paper chromatography.

The following substances have so far been detected: sucrose, obtained as crystals, m.p. 184°C., fructose and glucose, identified only by paper chromatography, and an unidentified crystalline solid, which is being investigated.

It has been shown that the presence of glucose and fructose is not due to hydrolysis of sucrose during the manipulation of the non-tans, although enzymatic breakdown of sucrose may occur during the bark drying process.

A hypoiodite oxidation in methanol indicates that glucose is present in very small amounts, while fructose constitutes approximately 3% of the non-tans. It is still hoped to identify glucose through the benzimidazole derivative, which is formed by the action of *o*-phenylenediamine on the potassium gluconate obtained after oxidation. Barium fructonate, unfortunately, undergoes decomposition during the *o*-phenylenediamine

reaction, so fructose will have to be characterized by some other derivative. Of the total non-tans, sugars and allied substances constitute approximately 40%, salts removed by ion exchange resins about 15%, and other substances so far not investigated approximately 45%. A spectrophotometric estimation of the non-tan polyphenols in this bark sample accounts for a quarter of the unknown substances. This, however, may be misleading, as the estimation is based on a tannin standard.

(*d*) ENTOMOLOGY

1. Effect of Bagworm Attack on Increment.

Increment plots laid out in seven different plantations were checked at the end of 1956 and plots in five plantations were again examined and measured in co-operation with the Silviculture Section during July, 1957. Plots in two plantations, viz. Kranskop and Spring Grove, will be harvested this summer.

2. Chemical Control.

(*a*) *Aerial spraying experiment.* Replicated sample plots were sprayed at Windy Hill from the air with 2 oz. Endrin and 1½, 2¼, 3, and 6 lb. Toxaphene per acre, each in light diesel oil, to test the effect of these insecticides on the wattle bagworm and other wattle fauna. All invertebrates which fell from the sample trees were collected on sheets at intervals after spraying and identified. The mortality of bagworms was assessed after ten to fourteen days.

The mean corrected mortality was significantly lower in the 1½ lb. Toxaphene treatment than in the others, which, however, did not differ significantly amongst themselves. In all cases, the kill was greater in the upper than in the lower parts of the tree crowns. There was no significant difference in the final percentage "fall-off" of bagworms in all plots, though in those treated with Endrin, the initial rate was higher. A very high kill was obtained in all but the 1½ lb. Toxaphene plots, but even the 6 lb. application was not sufficient to reduce the bagworm population to its endemic level. Many other wattle insects were also killed, and nearly two-thirds of the total were found to be beneficial. A paper on this experiment has been accepted for publication (Ossowski, 1957a).

(*b*) *Commercial spraying campaign*, 1956–1957. Approximately 10,000 acres were surveyed for this campaign and nearly 5,000 acres selected for aerial treatment. In all, 4,320 acres were sprayed and the application was supervised and the outcome assessed over an area of 4,000 acres. The insecticide used was Toxaphene dissolved in light diesel oil at the rate of one pound per gallon of solution; 2,392 acres were treated with two gallons and the remainder with three gallons per acre. The campaign started on the 7th November, 1956, and was concluded on the 11th January, 1957, with a break from the 22nd December, 1956, until the 6th January, 1957. In all, there were 39·5 spraying days, the actual time of flying and spraying being slightly over 69 hours, or 1¾ hours of flying and spraying per day. The average daily total was approximately 100 acres (i.e. approximately one acre per minute of flying time) irrespective of whether two or three gallons per acre were used. No correctional spraying was necessary.

This campaign has again shown that if organized properly and the treatment carried out efficiently under favourable weather conditions, fairly satisfactory results can be obtained in some categories of plantations, but only in terms of a single season. But in this, the fifth aerial spraying campaign, most of the mechanical and biological difficulties anticipated again arose, as they did during each previous campaign.

(*c*) *Commercial spraying campaigns*, 1952, 1953, 1954, *and* 1955. The study of the effect of these campaigns on wattle plantations and the cycle of bagworm infestation was continued. A paper containing some of the findings has been accepted for publication (Ossowski, 1957b).

3. Biological Control (Virus Disease in Bagworms).

(*a*) *Small-scale experiments*, 1955. Plantations sprayed with virus suspensions in 1955 were again examined in 1957. All bags (220) containing larvae were collected from a random selection of trees. The same number was gathered from an adjoining unsprayed block, and also from an untreated plantation lying over one mile away. In the sprayed block, two bags contained live bagworms, of which one was a healthy female prepupa and one a virus-infected male pupa. In the adjacent plantation, five bags contained live worms, of which two male pupae and two female prepupae were healthy and one female prepupa contained polyhedral crystals. In the plantation a mile away, 59 bags contained prepupae and pupae, of which only one female prepupa showed traces of a virus infection. In a second set of plots, where 300 bags were collected from each plot, the results were similar. Very few bagworms were found in the sprayed plantation, a somewhat higher population was found in the adjacent block, and more still on wattles growing further away.

(*b*) *Experiments*, 1956. Since the trials in 1955 had shown that an unnecessarily high concentration of virus had been applied and that the saturation point had already been reached at the lowest density, i.e. 10,000 polyhedra/cu.mm., the concentrations used in 1956 ranged from 1,000 to 10,000 polyhedra/cu.mm. The treated plantations were approximately 40 feet high and were sprayed with a "Bean" fire fighter at a nominal rate of approximately 6 gals. per acre. Some plantations were sprayed shortly before the hatching and others when the larvae were approximately 2–3 weeks old. In some blocks, the virus suspensions used were prepared from material collected from plantations remote from those treated, while other blocks were sprayed with suspensions prepared from the same locality in which they were used. Spray-dried milk powder (0·5%) was added as an adhesive to some suspensions. From an interim assessment of the results, it appears that mortality is high where suspensions were evenly distributed through the crowns. On inadequately covered trees, larvae developed fully, but appeared to feed less voraciously, and the trees were not defoliated. In untreated controls, a similar density of larval population resulted in partial or complete defoliation. Virus suspensions prepared from material collected from plantations remote from those treated appear to give a higher kill than suspensions collected from the same locality in which they were used. A paper on the outcome of these experiments is in preparation for publication elsewhere.

4. Identification of Wattle Insects.

Four insect species hitherto not recorded as potential wattle pests were observed damaging plantations and identified. Further details of these insects are given on page 29 of this report.

5. Records of Insect Outbreaks.

The records at present contain data concerning 49 species on over 240 farms and plantations.

6. Wattle Insect Collection.

This collection, started in 1953, now contains nearly 250 species.

REFERENCES

Ossowski, L. L. J. (1957a). The Chemical Control of the Wattle Bagworm, *Kotochalia junodi* (Heyl.) by Aerial Spraying. *Bull. ent. Res.*, **47**, (in the Press).

Ossowski, L. L. J. (1957b). Über *Kotochalia junodi* (Heyl.)—Psychidae—einen Gross-Schädling in Schwarzakazienwäldern von Südafrika. *Z. angew. Ent.* (Festschrift), **41**, (in the Press).

(e) BIOMETRY

The Sampling of Wattle Bark in the Plantation.

At present, the only satisfactory method of sampling bark from a tree is by grinding up the total bark and sampling the product. This process is laborious and, of course, destroys the tree. There remains, therefore, a pressing need for a method of sampling which is less time-consuming and which will preserve the tree more or less intact.

From previous work, it is known that, within a single tree, the tannin content of the bark decreases with increasing height. At some specific height, therefore, the tannin content will be equal to the average tannin content for the whole bark. If certain assumptions are made about the nature of the variation of the tannin content and the variation of the bark thickness, it can be shown that this particular height is given by the formula

$$\frac{(3D_2^2+2D_1D_2+D_1^2)H}{4(D_2^2+D_1D_2+D_1^2)} \qquad \text{.....(1)}$$

where D_1 = diameter at bottom of tree
D_2 = diameter at maximum strippable height of tree
H = strippable height of tree.

Thus, in the theoretical case of an ideal tree, it would be necessary only to take a bark sample at this predetermined height in order to get a representative analysis for the whole tree. In practice, however, because of the known local variations in tannin content, it is most unlikely that this would happen, and this is true of any method depending ultimately on the analysis of a single sample, no matter how selected. There is available, however, a device by which it should be possible to reduce substantially this source of error.

If it is assumed that the variation of tannin content with height is linear, the relation can be expressed by the equation $Y=mh+c$, where h is a height up the tree, Y the tannin content at that height, and m and c are constants varying from tree to tree. Thus, by collecting pellet samples at known heights spread over the strippable height of the tree and analysing them, these constants m and c can be calculated. By substituting the calculated height (1) into the equation, a figure equal to the average tannin content should be obtained.

To test this argument, nine trees were sampled as above and the final figure obtained in each case compared with an analysis of the whole bark of each tree. The results were as follows:

	Tannin %								
Estimate	44·4	39·2	43·2	39·4	43·5	40·2	35·4	42·0	37·9
Whole bark	42·9	39·2	42·8	39·1	43·3	39·0	33·8	39·4	37·8
Error..	1·5	0·0	0·4	0·3	0·2	1·2	1·6	2·6	0·1

Mean error = 0·99
Variance of error = 0·7970
95% confidence limits for the error = 0·99 ± 2·06.

The consistent bias in these results indicates that the theory does not precisely fit the facts. The variance of the error, however, is not large and further work to determine its origin and attempt its reduction appears to be justified.

If a plot of trees were being sampled, it should be possible to take single pellet samples at this predetermined height, relying on the averaging effect of tree replication to reduce the error due to local variations. This remains to be tested in practice.

PROGRESS REPORTS AND PAPERS

A LIST OF FUNGI COLLECTED IN WATTLE PLANTATIONS

By K. ROBERTS

Fungi collected in the course of routine silvicultural operations are listed according to habitat and the frequency with which they were encountered.

In September, 1956, a collection was started of fungi found growing in wattle plantations. Most of the species noted, however, are not associated with wattle only, because many of them are essentially woodland saprophytes with the primary requirements of lignified material and moisture.

While certain wound parasites such as *Amauroderma rude* (Berk.) G. H. Cunn. and *Schizophyllum commune* Fr. are known to contribute to the wattle disease known as "black butt", other species, e.g. *Ganoderma applanatum* Pat. and *Lenzites palisoti* Fr., occur almost as frequently. The frequencies of individual species within a fungal community may be inter-related; undoubtedly, the combined effect of the fungal mycelia plays a large part in the destruction of lignified material such as brushwood, tree stumps, and dead trees in the re-established plantation. Apart from the two wound parasites mentioned earlier, only three of the species included in this collection were found to have extended their activities to living wattle trees.

The observations given below did not arise from a deliberate search, but were incidental to routine silvicultural field work and advisory visits. With the exception of one locality near Lusikisiki, all the twelve sites from which fungi were collected are in Natal and lie within a broad strip running north-east from Pietermaritzburg to Kranskop and extending, at its widest part, from the Karkloof to Harburg.

It is probable that the order of frequency in which the species are listed will vary according to the locality and the time of the year. The order given is based only on the frequency of occurrence observed during this collection. Further, there is little doubt that continued and closer observation will reveal many additional species. Fuller investigations may indicate that the occurrence of certain species is governed by factors such as soil type, rainfall, and host.

In addition to the species listed below, four unidentified specimens were collected. While one of these fungi occurs abundantly and one occasionally, two are thought to be rare. The species are arranged in habitat groups, each of which is sub-divided into four frequency sub-groups as follows:

(*a*) Abundant —widely found in plantations throughout the wattle growing area. May be thinly distributed in any locality or may occur profusely.

(*b*) Common —frequently seen from time to time in many plantations, but not consistent in their occurrence. Often locally well represented.

(*c*) Occasional —usually not found in large numbers, but occurring occasionally in different parts of the wattle growing area. Never very prominent.

(*d*) Rare —very infrequently seen and almost always occurring as a single specimen only. Brief details of locality and date of collection are given for each species in this sub-group.

An asterisk indicates that the species occurs in more than one habitat group.

GROUP 1

Found on decaying stumps and dead wood.

(*a*) 11. **Amauroderma rude* (Berk.) G. H. Cunn.
53. *Ceratiomyxa fruticulosa* Macbr.
23. *Ganoderma applanatum* Pat.
13. **Lenzites palisoti* Fr.
37. *Poria* sp.
12. **Schizophyllum commune* Fr.
60. *Trametes* sp.

(*b*) 35. *Corticium luteocystidiatum* Talbot.
1. *Dacromyces* sp.
66. *Fomes* sp.
51. *Fuligo septica* Gmel.
24. *Ganoderma lucidum* Karst.
33. *Grandinia bicolor* Talbot.
4. *Hormomyces aurantiacus* Bon.
9. **Lentinus stuppeus* Klotzsch.
69. *Polyporous arcularius* (Batsch. ex. Fr.) Fr.
10. *Polystictus sanguineus* (Linn. ex Fr.) Fr.
21. *Polystictus versicolor* (Linn. ex Fr.) Fr.
28. *Trametes cingulata* Berk.
34. *Trametes griseo-lilacina* v.d.Byl
61. *Trametes violacea* Lloyd.
5. *Tremella* sp. indet.

(*c*) 20. *Corticium* sp.
38. *Daldinia concentrica* (Bolt. ex Fr.) Ces. & De Not.
17. *Hypholoma fasciculare* (Huds. ex Fr.) Quél.
3. *Hypoxylon* sp.
70. *Irpex* sp.
19. *Oidium* sp.
18. *Polystictus occidentalis* (Klotzsch) Fr.
71. *Scytinostroma* sp.
7. *Solenia natalensis* W. B. Cooke.
26. *Trametes acupunctus* Berk.
68. *Tremella* sp. indet.

(*d*) 49. *Cortinarius* sp. indet. Bloemendal Farm, Pietermaritzburg, 12.ii.57.
52. *Stemonitis* sp. Boughton Plantation, Pietermaritzburg, 26.ii.57.

GROUP 2

Found on wet, decaying twigs in brushpiles.

(*a*) 47. *Crepidotus* sp.
27. *Irpex flavus* Klotzsch.
44. *Mycena* sp.
40. *Phillipsia* sp.
39. *Plectania* sp.
14. *Phlebia strigoso-zonata* (Schw.) Lloyd.
29. *Stereum australe* Lloyd.
43. *Xylaria* sp. indet.

(*c*) 32. *Polystictus pinsitus* Fr.
31. *Stereum hirsutum* (Willd.) Pers. ex S. F. Gray.

(*d*) 41. An undetermined Discomycete. Bloemendal Farm, Pietermaritzburg, 31.i.57.

GROUP 3

Found in humus and on bare soil.

(*a*) 15. *Laccaria laccata* (Scop. ex Fr.) Berk. & Broome.
13. **Lenzites palisoti* Fr.
64. *Scleroderma cepa* Pers.

(*b*) 72. *Coprinus plicatilis* (Curt. ex Fr.) Fr.
30. *Coprinus* sp.
6. *Dacryopinax spathularia* (Schw.) Martin.
55. *Geastrum* sp. indet.
9. **Lentinus stuppeus* Klotzsch.
25. *Lycoperdon* sp. indet.
63. *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.
46. *Ramaria* sp.
42. *Thel^phora terrestris* Ehrh. ex. Fr.

(*c*) 36. *Agaricus campestris* Linn. ex. Fr.
57. *Amanita* sp.
45. *Favolus* sp.
16. *Inocybe* sp.

(*d*) 54. *Aseroë rubra* La Bill. ex Fr. Otto's Bluff, Pietermaritzburg, 10.i.57.
59. *Dictyophora* sp. Karkloof, Natal, April, 1957.
48. *Tubaria* sp. (?). Bloemendal Farm, Pietermaritzburg, 12.xii.56.

GROUP 4

Found on living trees or fresh stumps.

(*a*) 11. **Amauroderma rude* (Berk.) G. H. Cunn.
12. **Schizophyllum commune* Fr.

(*d*) 22. *Corticium salmonicolor* Berk. & Br. Lusikisiki, 20.vi.55.
62. *Hydnum henningsii* Bres. sensu lato. Corporation Plantation, Pietermaritzburg, 3.ii. 57.
67. *Polystictus hirsutus* Fr. Broadmoor, Nr. Wartburg, 20.v.57.

GROUP 5

Found on miscellaneous substrata.

(*a*) 58. Isaria psychidae Pole-Evans (on wattle bagworm, *Kotochalia junodi* (Heyl.)).
2. *Penicillium* sp. (on *Amauroderma rude* (Berk.) G. H. Cunn.).

Examples of most of the above species are at present kept at the Wattle Research Institute, Pietermaritzburg, and the collector's number is given for each species.

NOTES ON WATTLE INSECTS OBSERVED DURING THE PERIOD 1956–1957

By L. L. J. OSSOWSKI

An account is given of the insects observed damaging wattle plantations in Southern Africa during 1956–1957 and of the areas affected. Four insects not previously recorded as wattle pests are listed.

The numbers of some insects increased in the year under review, notably the wattle noctuid and wattle webworm. Four other insect species, so far not recorded as potential wattle pests, were observed to do considerable damage to plantations. A decrease was noted in the population of the lasiocampids and of some chafers.

I. ORDER : LEPIDOPTERA

Family: *Psychidae*

1. *Wattle Bagworm*, Kotochalia (*formerly* Acanthopsyche) junodi (*Heyl.*).

Nearly 100,000 acres of wattle plantations were infested with bagworms during the past season, the main centres of infestation being in the Midlands of Natal, particularly in the New Hanover and Umvoti Magisterial Districts with some 40,000 acres infested and nearly 8,000 acres defoliated, and where during the coming season defoliation over larger areas is expected. In the Transkei, plantations were lightly infested, but it appears that the infestation is on the up-grade. In Pondoland East, especially around Lusikisiki and Flagstaff, the second year of the prodromal stage has been reached and the eruptive stage may start during the coming season; some 1,500 acres may become defoliated. In the southern area around Harding, the infestation was in the first year of the prodromal stage, but some defoliation in the drier parts of that area may take place in 1957–58. At present, the south-easterly part of the Karkloof carries a fairly heavy bagworm population and some plantations in the lower-lying parts will suffer defoliation. Partial defoliation may occur around Lion's River, where the infestation entered the first year of its prodromal stage during the period under review.

Around Kranskop, the bagworm population has steadily increased and during the coming season a slight defoliation of smaller areas may occur. An increase of bagworms was noticed in Zululand (north of Melmoth), where some 400 acres of wattles growing on marginal land may become defoliated. In other parts of that district, the infestation is slowly building up, though no serious defoliation is to be expected during the coming season. North of Vryheid, the bagworm population was still at its endemic level, though here and there, a slight increase has been noticed. East of Vryheid, however, the infestation was rapidly building up and, in the drier parts, may enter the eruptive stage this season, when some 2,000 acres will become defoliated. In the Transvaal and Swaziland, the bagworm population appeared to be at normal level, though in some plantations, especially north and west of Piet Retief, the infestation was on the increase. In general, the development of the infestation in all areas, except some parts of the Midlands, was about the same as it had been around 1951 and 1952. In the centre of the Midlands where, in an area of approximately 400 square miles, some 50,000 acres were treated from the air with insecticide between 1952 and 1956, the infestation has not followed its established pattern of development and the population has remained at a dangerous level during those years.

A very high mortality of bagworms was caused by spiders of the *Araneus* and *Evophrys* species and by rodents, most probably *Mastomys natalensis natalensis*. It was also observed that the incidence of death of bagworm larvae due to the coleoptera-predators *Diphyllus clavatus* Arrow and *Lopholagria villosa* Thunb. was higher in the year under report than in previous years. Mortality due to *Isaria* was again particularly high in plantations of the mist belt; in blocks growing in drier areas, the brown fungus, an

Entomophthora species, was very much in evidence. Death caused by a virus disease amounted in some plantations to nearly 25 per cent. This virus, causing polyhedrosis, belongs to the nuclear type, which does not take Giemsa stain, but stands out from the stained background (Pl. I, Fig. 1). Outward symptoms of this disease are usually difficult to see in larvae; they do not become visible until the bag is cut open, and then only in individuals older than the second instar. Younger larvae which have died from this disease disintegrate in their bags and only under the microscope can the presence of polyhedral bodies be detected. In older larvae, infestation in the advanced stage may be recognized by the black colour of the body, which sometimes may become flaccid and disintegrate, leaving behind a dark stain on the inside of the bag. Recently, however, bags were found from which dead or moribund older-instar larvae protruded (Pl. I, Fig. 2). All these specimens showed virus infection. It seems, therefore, that while younger infected larvae usually die within the bag, older ones may leave or try to leave the bag before dying. This may explain the large number of empty bags found in recent years in plantations sprayed experimentally with virus suspensions.

Family: *Lasiocampidae*

2. *Small Wattle Lappet Moth,* Anadiasia punctifascia *Wlk.*

Very few larvae were observed during the year, except in plantations on the experimental farm at Bloemendal, where some 130 acres were lightly infested, but no damage was done.

3. *Grey Wattle Lappet Moth,* Pachypasa truncata *Wlk.*

Approximately 50 acres of a young plantation were defoliated in the Vryheid district.

4. Pseudometa dollmanni *Tams,*

Larvae of this lasiocampid defoliated some 20 acres of a young plantation in the Inyanga district of Southern Rhodesia and it appears that the infestation is spreading. So far, no damage to trees older than eighteen months has been observed.

Family: *Noctuidae*

5. *Wattle Noctuid,* Achaea lienardi *Boisd.*

This insect was again widespread through some parts of the wattle belt and in all, nearly 5,000 acres were infested, of which some 2,000 acres were partially or completely defoliated. The infestation was particularly severe in the Albert Falls district and around Pietermaritzburg and Hill Crest, where the attack coincided with that of froghopper and wattle webworm. A shield bug, *Glypsus maestus* Germ. was again observed to destroy noctuid larvae of all instars. Also the black cuckoo, *Cuculus cafer cafer* Lichtenstein, which invaded infested plantations in flocks of from four to ten birds, was instrumental in reducing the larval population of the noctuids.

Family: *Agrotidae*

6. Pericyma mendax *Wlk.*

The very conspicuous larvae of *Pericyma,* which are bright green with parallel white stripes on the back and a white zig-zag stripe on the sides, are frequently to be found in plantations of all ages, but only in the past year has damage in very young stands become noticeable. The larvae are heavily parasitized by a tachnid, *Pales coerulea coerulea* Jaen.

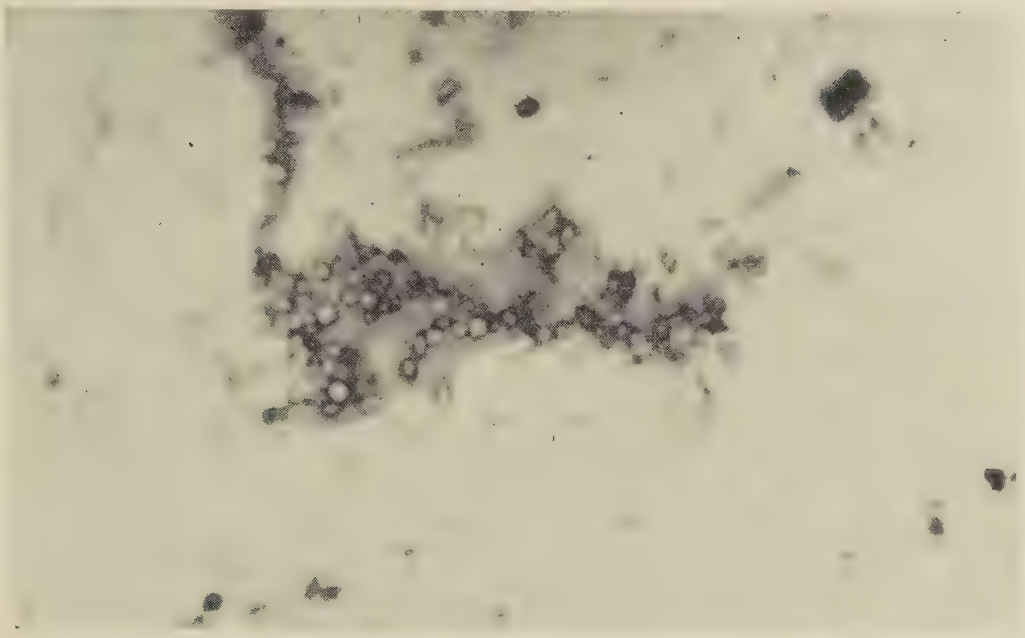


Fig. 1 (above). Nuclear polyhedral crystals ex *K. junodi* (x 1500).

Photo: D. E. van Dijk, Zoology Dept., University of Natal.

Fig. 2 (on right). Dead virus-infected fifth instar larva of *K. junodi* protruding from bag (approx. natural size).

Photo: Miss K. M. Nixon, Wattle Research Institute.

Family: *Tortricidae*

7. *Wattle Webworm,* Polychrosis incultana *Wlk.*

Outbreaks of this pest were observed around Albert Falls, Pietermaritzburg, and Hill Crest, where approximately 3,000 acres of plantations up to two years old were infested and damaged. Also, for the first time, this insect was observed to have invaded plantations in the Chipinga-Melsetter district of Southern Rhodesia, damaging them slightly. Since the attack was confined to some ten acres only, the nests containing larvae could be collected and destroyed. An *Apanteles* sp. (Braconidae) was found to parasitize the larvae.

II. ORDER : COLEOPTERA

Family: *Melolonthidae*

8. *Large Wattle Chafer,* Hypopholis sommeri *Burm.*

The damage done by these imagines in the year under report was less than in previous years. The areas particularly affected were Lion's River, Harding, Richmond, and Kranskop. In the last-named district, some 250 acres were partially defoliated. Around Fawnleas, larvae of this chafer destroyed 20 acres of newly established wattles.

9. *Small Wattle Chafer,* Monochelus calcaratus *Burm.*

This beetle also did less damage during 1956–57 than in the previous season. In all, 200 acres were reported to be damaged around Lidgetton and Kranskop.

10. *Mashonaland Chafer,* Eulepida mashona *Arrow.*

The population of this beetle in the wattle-growing area of Southern Rhodesia appears to have returned to its endemic level. Here and there, small outbreaks have been reported from the Chipinga-Melsetter district, but only 100 acres of very young plantations were destroyed by the larvae.

Family: *Chrysomelidae*

11. *Iridescent Wattle Chrysomelid,* Colasposoma fulgidum *Lef.*

Reports of occurrence of this pest were received from plantations near Lidgetton and Harburg, where approximately 150 acres were invaded.

12. *Green Wattle Chrysomelid,* Colasposoma semihirsutum *Jac.*

Little damage was done by this chrysomelid, and only approximately fifteen acres were slightly defoliated around Harburg. This beetle occurred together with *C. fulgidum.*

Family: *Curculionidae*

13. Ellimenistes laesicollis *Fhs.*

The number of these curculionids seems to be increasing, especially in the Noodsberg area, where more than 100 acres were completely destroyed in 1955–56. These areas were re-established, but as soon as the seedlings started to grow, they were again destroyed by the beetle. The life cycle is unknown, but there seem to be several generations per year, since adults may be found the whole year round.

14. Catamonus melancholicus *Boh.*

This beetle was reported for the first time to defoliate wattle plantations situated along the South Coast, where nearly ten acres were completely defoliated.

15. Auletobius decipies *Lea.*

Adults of this species were observed to damage shoots of younger wattles over some 30 acres around Fawnleas and Hilton. Sir Guy Marshall states (*in lit.*) that this curculionid has been reported from New South Wales, South Australia, and Tasmania, but has not previously been recorded in Southern Africa. It is highly probable that in Australia it is not a pest and has only become so in Southern Africa owing to the absence of its natural enemies. Nothing is known about the life cycle of this insect, which may have been introduced from Australia through seed.

Family: *Bostrychidae*

16. Apate indistincta *Murray.*

The occurrence of this bostrychid was reported only from Odzani, Southern Rhodesia, where it attacked and damaged around 20 acres of two-year-old wattle.

Family: *Cerambycidae*

17. *Red-banded Longhorn Beetle,* Pycnopsis brachyptera *Thoms.*

Damage was particularly severe in the Ahrens district, where, in one plantation, the leaders of young trees were cut off over some 100 acres and thin branches were ring-barked.

III. ORDER : ISOPTERA

Family: *Termitidae*

18. Macrotermes Natalensis *Haviland S. lat.*

Around Umzinto, more than ten acres of young wattles were completely destroyed by these termites and re-establishing meantime made impossible.

IV. ORDER : HEMIPTERA

Families: *Jassidae* (*Cicadellidae*) and *Capsidae* (*Miridae*)

19. *Large Green Jassid,* Bythoscopus cedaranus *Naudé,* and
20. *Brown Capsid,* Lygidolon laevigatum *Reut.*

There was again less evidence of this pest in 1956–57 in areas with higher rainfall, but in the drier part of the wattle growing area, damage was severe and more than 5,000 acres were damaged, especially in the Albert Falls district, around Hill Crest, Hilton, and Ahrens, and in Pondoland. Also more than 1,000 acres showed froghopper damage in plantations in the Transvaal.

In the lower-lying wattle plantations of the Chipinga-Melsetter district of Southern Rhodesia, froghopper has also become established and damaged some 150 acres there.

21. *Bagrada Bug,* Bagrada hilaris *Burm.*

This shield bug, black with a few bright orange and yellow spots, usually attacks plants belonging to the cabbage family, and was observed some years ago to attack and damage young poplars. During the season under review, it was reported to have destroyed several acres of young wattles near Otto's Bluff. Mainly tops of trees were attacked, resulting in damage similar to that caused by froghopper and twig wilter, *Holopterna alata* Westw.

PUBLICATIONS, 1956–57

Anon. .. .. *The Wattle Research Institute Report for 1955–1956 (Ninth Year)*. Pietermaritzburg, The Wattle Research Institute, October, 1956.

Gordon-Gray, C. G. "A Comparison of the Results of Estimating Black Wattle Tannin by the Official Hide Powder Method and by a Proposed Ultra-Violet Spectrophotometric Method". *J. Soc. Leather Trades' Chem.*, 1957, **41**, 269.

Moffett, A. A. .. .. "The Black and Green Wattle Progeny Trials at Sweetwaters". *Rep. Wattle Res. Inst. for 1955–1956* (1956), 30.

Ossowski, L. L. J. .. "Notes on Insects Observed during the Period 1955–1956". *Rep. Wattle Res. Inst. for 1955–1956* (1956), 37.

Ossowski, L. L. J. .. "Spraying Experiments with Insecticides against Wattle Bagworm (*Acanthopsyche junodi* Heyl.)". *Rep. Wattle Res. Inst. for 1955–56* (1956), 42.

Ossowski, L. L. J. (with J. G. Betrem) .. "The Nomenclature of *Acanthopsyche junodi* Heyl. (Psychidae)". *Proc. R. ent. Soc. Lond. B.*, 1956, **25**, 205.

Ossowski, L. L. J. .. "The Biological Control of the Wattle Bagworm (*Kotochalia junodi* Heyl.) by a Virus Disease. Part I. Small-scale Pilot Experiments". *Ann. app. Biol.*, 1957, **45**, 81.

Smithers, C. N. .. "A New Species of *Isophanes* (Caeciliidae, Psocoptera) from Natal". *J. ent. Soc. S. Afr.*, 1956, **19**, 29.

Smithers, C. N. .. "On *Philopsyche abdominalis* (Hym.: Ichneumonidae), a Parasite of *Acanthopsyche junodi* Heylaerts (Lep.: Psychidae)". *J. ent. Soc. S. Afr.*, 1956, **19**, 225.

Copies of most of the above publications may be obtained on application to the Institute.

BOOK REVIEWS

Ossowski, L. L. J. .. "Handbuch der Pflanzenkrankheiten", Bd. V, Dritte Lieferung, edited by H. Blunk. *J. S. Afr. For. Ass.*, 1956, **No. 28**, 64.

Ossowski, L. L. J. .. "Handbuch der Pflanzenkrankeiten", Bd. II, Zweite Lieferung, by C. Stapp. *J. S. Afr. For. Ass.*, 1957, **No. 29**, 63.